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Graphene-based hybrids for chemiresistive gas sensors

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HIGHLIGHTS

- Up-to-date evaluation of graphene-based gas sensors
- Hybrids of graphene with noble metals, metal oxides, and conducting polymers
- Systematic comparison of gas-sensing principles graphene-based hybrids
- Systematic comparison of gas-sensing properties of graphene-based hybrids
- Presentation of future outlook for graphene-based hybrid gas sensors

ABSTRACT

Gas sensors can detect combustible, explosive and toxic gases, and have been widely used in safety monitoring and process control in residential buildings, industries and mines. Recently, graphene-based hybrids were widely investigated as chemiresistive gas sensors with high sensitivity and selectivity. This systematic review is therefore timely and necessary to evaluate the success of graphene-based hybrids on gas detection and to identify their challenges. We review the sensing principles and the synthesis process of the graphene-based hybrids with noble metals, metal oxides and conducting polymers to achieve better understanding and design of novel gas sensors. Our review will assist researchers to understand the evolution and the challenges of graphene-based hybrids, and create interest in development of gas-sensing techniques.

Keywords:
Chemiresistive gas sensor
Gas detection
Gas sensor
Graphene
Graphene-based hybrid
Graphene-metal hybrid
Graphene-metal-oxide hybrid
Graphene-polymer hybrid
Nanocomposite
Sensing

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1. Introduction

Gas sensors can detect combustible, explosive and toxic gases, and have been widely used in safety monitoring and process control in residential buildings, industries and mines. However, sensitivity and selectivity are still bottlenecks for current solid sensors of gases. Graphene has attracted much attention as a gas-sensing material since its discovery in 2004 [1] because of its unique characteristics, such as electrical and thermal conductivity, low electronic noise, large surface-area-to-volume ratio, high chemical stability and excellent